Hazards

Mountains may seem invincible, but they are highly susceptible to natural hazards. Shifting continental plates at their base cause earthquakes and volcanic eruptions. Air condenses on their slopes and around their peaks forming rain and snow that can trigger devastating floods and avalanches. Steep mountain slopes turn rocks, mud and debris into fast moving deadly flows.

These events put mountain people -- already among the world's poorest and hungriest -- at constant risk of calamity. As global warming upsets the delicate balance of mountain ecosystems and population pressure pushes people into dangerous areas, these events are becoming more frequent. Yet, although the forces of nature cannot be tamed, steps can be taken to reduce the risk of disaster.

Natural hazard plus vulnerability equals disaster

The nature of mountain ecosystems increases the chance of floods, droughts, eruptions, hurricanes, avalanches, debris flows, landslides and other hazards.

These natural events become disasters when mountain people active in these places get in harms way. Many people in mountain regions live in extreme poverty, forcing them to settle in unsafe areas. Their isolation hampers efforts to warn of impending threats and leaves them waiting longer for emergency help when tragedy strikes. And because mountain people reside far from centres of commerce and suffer high rates of illiteracy, their voice is limited in government policies and decisions. At the same time, fragile mountain environments are under increased stress from the growing demands of modern society. Excessive logging strips protective forests. Development of tourism infrastructures upsets fragile ecological balances. Inappropriate road construction makes mountain slopes unstable. Mismanaged mining raises the possibility of landslides. Global warming is first noticeable in mountainous areas, where melting icecaps overfill glacial lakes leading to flash floods.

So it is no wonder that more than half of the deaths caused by natural disasters occur in mountains and adjoining lands. And long after reporters have left the scene, mountain communities struggle to recover, poor at the outset and left with even less.

Protect, prevent and forewarn

It is not possible to completely protect people from hazards; nor is it wise to wait until a catastrophe occurs. More effective and less costly is a preventive strategy to keep damage to a minimum.

One of the most obvious steps is to identify areas exposed to natural hazards and restrict development in that area. By using historical records, computerized geographic information systems and remote sensing tools, governments can create hazard maps showing where these events are most likely to occur. Risk assessment analysis helps to make more informed decisions about land use, including where to place infrastructure such as roads, railways and energy lines.

Experts estimate that inadequate land use planning was behind 50 to 75 percent of the huge damage and loss of life caused by the floods, mudslides and landslides of Hurricane Mitch in Central America in 1998.

Early-warning systems help people to seek shelter before conditions turn disastrous—especially important in isolated mountain areas where communication is limited. In 2000 a monitoring system prevented many deaths in China when a huge landslide sent a flash flood 50 meters high racing down the Yigong River. However, cross-border communication did not reach downstream areas in India and more than 30 people perished.

Improved drainage is often a key factor in limiting hazards in mountains. By lowering groundwater levels, water pressure drops and landslides become less likely. Conserving and replanting forests is also effective. Forests form a barrier against floods or

mudslides, slowing the force of the flow. They catch rain and allow part of it to evaporate while their roots form a protective net, holding together soil and rocks. However, forest cover does not protect from deep rooted landslides, caused by saturated soils and unstable geological conditions.

Retaining walls are another option to prevent, divert, or contain extreme natural events such as avalanches. Vegetative cover can stabilize vulnerable surface areas such as slopes adjoining roads. In high-population density zones such as the Swiss Alps, organizational tactics such as blocking roads, evacuating houses and mobilizing emergency assistance can save lives.

Better information is needed to raise awareness of disaster risk. Training and hazard mitigation planning can help mountain people build capacity and reduce their exposure to calamity.

Thawing ice, moving mountains

Over the past century, average global temperatures have risen about 0.6°C. As the Earth warms, snow melts, sea levels rise and a cascade of changes in the delicate environmental balance occur, especially in mountain areas.

Already the glacier atop Mount Kilimanjaro in Tanzania has shrunk by more than 80 percent and may disappear altogether in 15 years. Icecaps on the Andes mountains supplying drinking water, irrigation and hydropower to Peru and Bolivia are melting so fast that nearby villages are in danger of flash floods. Mountain glaciers are also retreating in Ecuador, Venezuela, the European Alps, the Himalayas, New Guinea, and the United States of America.As glaciers melt they put increased pressure on mountain lakes, increasing the probability of the phenomenon known as ‘glacial lake outburst flood’, or GLOF. In 1985, the Dig Tsho glacial lake in Nepal overflowed, sending a torrent of water rushing downhill, destroying 14 bridges and causing $1.5 million worth of damage to a hydropower plant under construction. Six years later another glacial lake burst. Researchers now warn that dozens of mountain lakes in Nepal and Bhutan are so swollen they could burst their seams within the next five years.

With help from its partners, the Kathmandu-based International Centre for Integrated Mountain Development (ICIMOD) is establishing an early-warning system for the eight south Asian countries that make up the Hindu Kush-Himalayan region. This initiative will use computerized techniques to monitor glaciers and glacier lakes to ensure that action can be taken before it is too late.

Ironically, once mountains have lost their snowcaps, villages that once risked floods could face a future of drought. Higher temperatures are also reducing permafrost areas, creating conditions favourable to rock falls and landslides. And warmer conditions may allow disease-carrying organisms to survive at higher altitudes, exposing already vulnerable mountain communities to illness.

Some scientists believe that global warming is increasing the frequency of storms, droughts and other extreme weather events. Climate records and long-term forecasts can help policymakers be better informed about the effects of global warming.

More space, less risk?

Traditionally, mountain communities avoided settling in hazard zones but when they did, they accepted their fate. They also adopted farming methods that helped to avoid erosion, set up flood-reducing canals and dykes and took other actions to reduce disaster risk. Today, population pressure is leading to increased building in dangerous areas and 40 of the world's 50 fastest growing cities are located in earthquake zones. Society demands ever more space and access to remote areas but expects modern technology to assure complete safety.

But it is not technically or financially feasible to remove all threats. In 2000, the Swiss government spent more than 100 million Swiss francs (65 million euros) on protective structures. That was the same year heavy rains loosened a huge chunk of soil and rock from the hillside above the village of Gondo, destroying half the village and killing 13 people.

Still, even modest expenditures can make a significant difference. Recurring debris flows in the Laogan Ravine in China had caused losses of almost US$ 5 million. Through a system of civil- and bio-engineering measures costing only US$ 170 000 these events were brought to a halt.

Nations will need to balance the needs of supporting a healthy economy and a growing population with efforts to limit danger.

New opportunities, new threats

Many mountainous regions used to be largely off-limits to the outside world. Today, even Mount Everest is within reach of almost anyone willing to pay a specialized guide. But while globalization has increased access and paved the way for attractive financial prospects, there are also perils.

Tourism provides up to 90 percent of regional income in popular holiday destinations in the Alps, the Andes, the Himalayas and the Rockies. But when unregulated it can degrade and stress fragile mountain ecosystems, destroying the very qualities that make these environments so alluring in the first place and leaving mountain communities more vulnerable to tragedies.

Increased demand for minerals and metals combined with advances in technology have made it possible to mine rich mountain resources. While mining can provide handsome revenues, it also pollutes water sources, reduces biodiversity and clears protective trees and vegetation.

The appeal of higher incomes has encouraged some mountain communities to abandon subsistence farming and plant cash crops. But with limited access to market information and no guarantee of a sale, it can be risky business. And farmers who give up terrace farming miss out on the benefits of reducing soil erosion.

Key facts

- Over the last century, earthquakes, floods and other cataclysms have killed more than 1.5 million people in mountainous countries. About 90 percent of disaster victims live in developing countries.

- When extreme weather combines with poor environmental management, the results can be disastrous. Torrential rains falling on denuded and unstable slopes in Venezuela in 1999 triggered a landslide that killed more than 20 000 people.

- The number of disasters worldwide has more than tripled since the 1970s but better prevention and emergency response have decreased the death toll by more than half.

- Though the Merapi volcano on the Indonesian island of Java is the country's most active, its fertile slopes host one of the world's highest population densities. To counter the menace, 200 people have been taught emergency preparedness, potentially benefiting 12 600 villagers.

- Switzerland has long recognized the importance of hazard protection. A proclamation issued in the central Swiss town of Andermatt in 1397 urged the population to protect the nearby forest because of its ability to hold back avalanches.

Expert Sources

Prof. Li Tianchi
Chengdu Institute of Mountain Disaster and Environment
Chinese Academy of Sciences
No. 9, Section 4, South People's Rd.
Chengdu, 610041, China
tianchi@hotmail.com

Peter Greminger
Director, Protection Forest and Natural Hazards Sector
Swiss Forest Agency
BUWAL
Postfach
CH-3003 Bern, Switzerland
Tel.: +41 31 324 78 61
Fax: +41 31 324 77 89
E-mail: Peter.Greminger@buwal.admin.ch

Thomas Hofer
Forestry Officer, Sustainable Mountain Development
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00100 Rome, Italy
Tel: +39 06 5705-3191
Fax: +39 06 5705-5137
E-mail: Thomas.Hofer@fao.org
Web site: www.mountains2002.org